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Knowledge Management Factors and Its Impact on Green Innovation: A Systematic Literature Review

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Abstract

Environmental problems are becoming more severe due to firms' operational activities, such as industrial production and manufacturing, which damage the environment. Consequently, Green Innovation (GI) is necessary to mitigate these negative effects. Although studies indicate that Knowledge Management (KM) impacts companies with GI, the specific impacts and mediating roles remain unclear. This study aimed to identify factors affecting KM in companies with GI and to understand how KM influences these companies. Using Kitchenham's systematic literature review of 20 articles from the past five years, this study found that green entrepreneurial orientation, green transformational leadership, knowledge-oriented leadership, embeddedness, stakeholder pressure, big data analytics capabilities, and training influence KM in companies with GI. Additionally, KM affects companies with GI directly and indirectly through human capital, sustainable development practices, environmental awareness, and green creativity. A conceptual model was proposed to illustrate these relationships, providing insights and recommendations for optimizing KM implementation in GI settings.

A. Introduction

Nowadays, environmental issues have become a serious problem globally [1]. Failure to prioritize the environment and its natural resources poses a significant risk to both living organisms and ecosystems [2]. The adverse effect on the environment and climate has increased dramatically as a result of the rapid natural resource scarcity and the release of hazardous compounds that precede economic growth [3]. Because of the devastating effects of climate change, governments, businesses, and individuals all over the world are becoming more and more conscious of how important it is to protect the environment [4]. Environmental concerns are gradually changing how society views actions that could eventually damage ecosystems [1]. This change has an impact on business success in addition to economic development [5]. As such, it is recommended that companies develop innovative solutions to lessen the negative environmental effects of their activities. To do it, businesses need to employ green innovation (GI) [6], [7].

The definition of GI is a procedure that helps develop new technologies and production methods to lessen the hazards to the environment and the effects of resource exploitation [8]. GI has developed into a pivotal instrument for companies striving to increase their sustainability and market share [9]. When GI is implemented properly, businesses can obtain a competitive edge, solidify their place in the market, draw customers, and offer environmentally friendly services [6]. Additionally, GI is essential in helping businesses, organizations, and society achieve environmental sustainability and boost economic performance [6, 10, 11]. As a result, GI has become popular among towns and organizations as a strategic tool for promoting both economic growth and environmental protection [11].

Recently, organizations have recognized the importance of a green environment, prompting them to focus on redesigning their operations and management systems [7]. Thus, they started to see experience, excellence, and ecologically responsible operations as advantageous strategies to get a competitive advantage in the present market [7]. However, achieving organizational success in terms of GI hinges on several factors associated with Knowledge Management (KM) [6]. Companies are putting corporate culture into practice by encouraging employees to share their knowledge, talent, and experience. Due to systemic features and technological uncertainties, this demands for the adoption of a green corporate culture, the encouragement of organizational cooperation for the innovation implementation, the demonstration of senior management's dedication, the sharing of knowledge to integrate internal and external sources, and the enforcement of environmental regulations [6]. Several studies acknowledged that one of the key factors that affect GI adoption is KM [12].

Knowledge stands as the fundamental and most critical asset of organizations, and the organization's value is closely linked to how knowledge resources are managed [13]. These resources empower organizations to excel in the business landscape by extracting insights, expertise, creative ideas, and innovation from employees. This allows them to adapt, innovate, gain a competitive edge, and enhance operational performance to compete in the business environment [14]. Therefore, KM is essential to maximize knowledge contribution. KM, as a discipline, is dedicated to effectively managing and optimizing an organization's knowledge resources [14]. It encompasses various

strategies and practices for creating, sharing, and leveraging knowledge within an organization [15]. KM is built upon KM solutions (includes process and system), and is supported by KM foundation, (includes infrastructure, mechanism, and technology) [16]. The KM process pertains to how organizations generate, share, and leverage knowledge resources across different functional areas [17]. Multiple studies highlight KM primary processes as creating, sharing, transferring, and applying knowledge, followed by acquiring and utilizing knowledge as the secondary processes [18].

According to Borghini [19], [20], knowledge significantly contributes to creativity and the generation of innovation. As a result, a strong connection exists between the knowledge within an organization and its ability to innovate [21]. Additionally, the mechanism of knowledge sharing that enhance organizational innovation are equally vital [22]. The innovative initiatives of corporations are propelled forward by the KM process. [21]. KM is a term to describe a company's capability to effectively utilize and combining various knowledge sources [22]. This capability enables the conversion of existing resources into valuable products, improved processes, and various forms of innovation [23]. In essence, KM facilitates the transformation of changes and innovations into enhancements [24], [25].

Over the past few years, studies on GI have increased significantly. However, there hasn't been any substantial research that specifically identifies the KM factors that can influence GI within organizations. This study aimed to understand how KM impacted companies that implemented GI. This study advances knowledge on the effects of KM on businesses involved in GI projects. Two research questions are the focus of this study: 1) What are the factors that affect KM in companies with GI? and 2) How does KM influence companies with GI?

B. Research Method

As seen in Figure 1, this study used the Kitchenham's Systematic Literature Review (SLR), which consist of three phases: planning, conducting, and reporting the review [26].

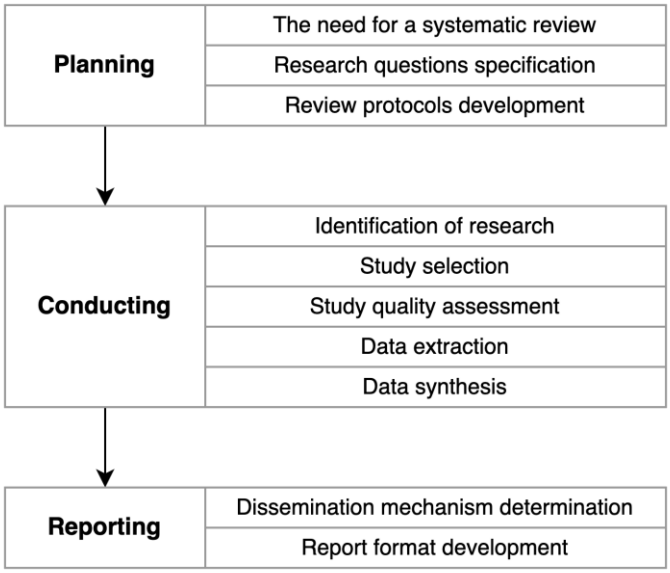

Figure 1. SLR Process

At the planning phase, we identified the necessity for a systematic review, grounded in recent studies, examining the impact of KM on GI. This need stems from researchers' imperative to comprehensively summarize all available information and derive more generalized conclusions about this phenomenon. Furthermore, we specified two research questions and formulated the review protocol, as seen in Table 1.

Table 1. Review Protocol

Protocol	Description
Database	Scopus, ScienceDirect, IEEE Xplore, ProQuest, and Emerald Insight
Keywords	“green innovation” AND “knowledge management” AND impact
Inclusion Criteria	Written in English, published year from 2018 to 2023, publication type "journal" or "conference", and the focus on the KM factors and KM impact on GI.
Exclusion Criteria	Written in a language other than English, duplicated paper, unaccessible, literature review, conference notes, and speaker notes.
Quality Assessment Criteria	• Clear research objectives • Contain background information, research context, literature review, and related work from previous studies • Outline the research methodology • Provide clear research findings, relevant conclusions, and future recommendations • Indexed by Scopus
Data Extraction Strategy	We developed a data extraction format that contains relevant information, such as demographic data and research result based on our research questions. Next, we read each paper carefully to extract the information according to the format. We use electronic form to store the information.
Data Synthesis Strategy	Based on the extraction process's results, we used a data-driven strategy to addressed the research issues by comparing every study.

During the conducting phase, research identification involves utilizing predetermined search terms on five electronic databases of journals. Mendeley Desktop was employed to organize the references acquired from the literature search. Study selection proceeded through three steps: initial search selection, title and abstract selection, and full-text reading, as illustrated in Figure 2.

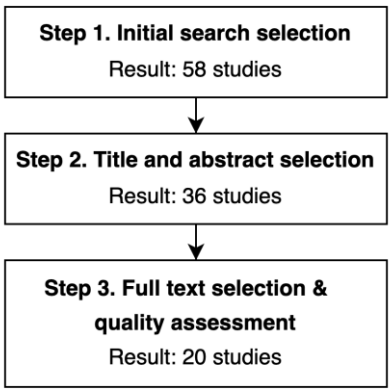

Figure 2. Selection Process

From the initial search, we have gathered 58 literature. Then, 36 literature passed from title and abstract selection. After reading the full-text literature thoroughly, 20 literature are selected. We also conducted a quality assessment with eight predetermined criteria. A literature is considered passing the quality assessment if at least five of the criteria are met. We found that each of the 20 literature met all the criteria. The selected literature are shown in Table 2.

Table 2. Selected Literature

Sources	Literature	Total
Scopus	[3], [7], [10], [32], [37], [54], [56], [57], [63]	9
ScienceDirect	[29], [44], [59]	3
IEEE Explore	[62]	1
ProQuest	[51], [58]	2
Emerald Insight	[30], [39], [55], [60], [61]	5

Furthermore, we extract and synthesize data from the selected literature after the quality assessment aligned with the predefined strategy in the planning phase. The review encompassed articles presented in Table 2, spanning from 2018 to 2023. Figure 3 depicts a distribution of chosen literature' publication years.

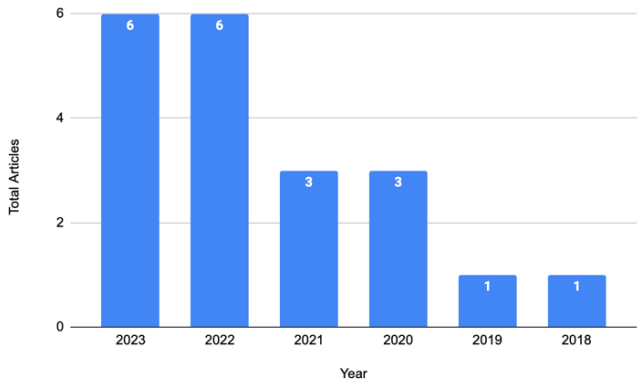

Figure 3. Literature by Publication Year

The literature are published by 11 different publishers, as shown on Table 3. These includes Business Strategy and the Environment, Engineering, Construction and Architectural Management, European Journal of Innovation Management, International Journal of Organizational Analysis, Journal of Cleaner Production, Journal of Innovation & Knowledge, Journal of Knowledge Management, Journal of Southwest Jiaotong University, Knowledge and Process Management, Kybernetes, and MDPI.

Table 3. Literature by Publisher

Publishers	Literature	Total
Business Strategy and the Environment	[3], [54], [62]	3
Engineering, Construction and Architectural Management	[32]	1
European Journal of Innovation Management	[30]	1
International Journal of Organizational Analysis	[61]	1
Journal of Cleaner Production	[29], [37], [44], [57], [59]	5
Journal of Innovation & Knowledge	[7]	1
Journal of Knowledge Management	[39], [55], [60]	3
Journal of Southwest Jiaotong University	[56]	1
Knowledge and Process Management	[10]	1
Kybernetes	[63]	1
MDPI	[51], [58]	1

We utilized several questions to support the data extraction process. These questions consist of title of the paper, author, publication year, country, keywords, research methodology, research questions, and research findings. Additionally, we adopted a data-driven methodology to synthesize information based on the outcomes of the SLR conducted. We created a comparison list for every paper using this strategy, taking certain factors into account. These criteria cover the

influence of KM on GI-related enterprises as well as the elements influencing KM on such companies.

C. Result and Discussion

The implementation of KM can be affected by various factors which in turn has an impact on GI in companies. Seven factors are identified as being important to KM implementation. These include Green Entrepreneurial Orientation, Green Transformational Leadership, Knowledge Oriented Leadership, Embeddedness, Stakeholder Pressure, Big Data Analytics (BDA) Capabilities, and Training, as outlined in Figure 4.

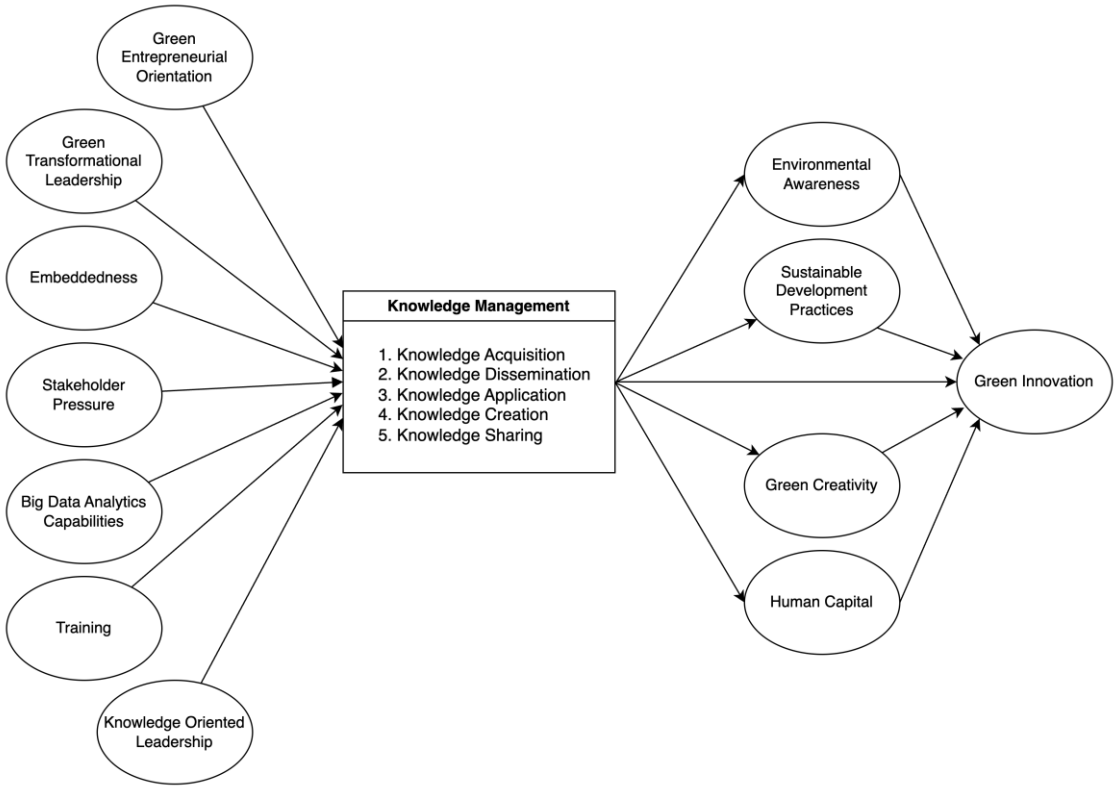

Figure 4. KM Factors and Impact on GI

1. Factors that Affect Knowledge Management on Companies with Green Innovation

Green Entrepreneurial Orientation (GEO) is a proactive strategic orientation at the firm level, involving the identification and capture of eco-friendly business opportunities through an evaluation of risks and benefits [27]. It serves as a dynamic competency, facilitating companies in identifying, capturing, and maintaining environmental initiatives [28]. As highlighted by references [29] and [30], GEO is crucial in KM implementation for the establishment of GI. GEO encourages companies to place a high priority on acquiring and applying green knowledge and skills in order to create cutting-edge environmentally friendly processes and products [29]. Additionally, it enables companies to explore, gather, and generate green information and ideas [29]. These observations align with the research findings of [30] which suggest that GEO elements such as experimentation and risk-taking impact the creation and sharing of knowledge.

From a KM perspective, a company that fosters risk-taking and experimentation can facilitate learning, as well as the creation and distribution of knowledge.

According to Reference [30] Knowledge Oriented Leadership (KOL) significantly impact KM process including Knowledge Creation (KCR), Knowledge Acquisition (KAC), Knowledge Sharing (KSH), and Knowledge Application (KAP). Typically, individuals in an organization are reluctant to share knowledge or information unless there is favorable motivation and support. This reluctance is in the perception of knowledge as a valuable asset for competitiveness and power [31], [32]. Therefore, leadership is crucial for motivating employees to actively participate in knowledge sharing [30], [32]. Reference [32]specifically mentioned the Green Transformational Leadership (GTL) can positively impact knowledge sharing. GTL is a leadership framework designed to motivate subordinates to enhance GI capabilities and enabling them to achieve environmental goals [33]. GTL promotes knowledge sharing and integration by adopting a forward-looking approach, setting role models, inspiring innovative ideas, and fostering trust through effective communication and consideration of subordinates' needs [32]. The study further highlights how green transformational leaders' actions frequently inspire employees to express their opinions, continuously arouse knowledge creation, and enhance GI performance [32], [33].

Knowledge is an important factor in fostering innovation [34], [35]. The willingness of employees to learn and combine knowledge, both internally and externally, is crucial for innovation development [32], [36], [37]. By harnessing internal and external knowledge, organizations can enrich their environmental knowledge inputs, leading to the promotion of greater GI [38]. To maximize the innovation development process among employees, companies can conduct training to facilitate the process of knowledge acquisition [39]. Reference [39] proves that training positively influences knowledge acquisition. Training can support organization to create, exchange, and utilize organizational knowledge which contributes the enhancement of GI. It enables employees to acquire broader knowledge and skills by providing access to new knowledge, skill, and abilities [39], [40]. As a result, employees will be empowered to promote GI [39].

According to research [37], knowledge sharing in the context of supply chain companies can be facilitated by embeddedness within a network and the interchange of beliefs related to justice. This can lead to the enhancement of GI. It makes it easier for businesses to learn from other network members, integrate innovations with resources, and gain direct or indirect access to knowledge and information [37], [41], [42]. This idea is also mentioned in [41], emphasizing that embeddedness is crucial for influencing partners' willingness, building trust, and ensuring consistent knowledge sharing among stakeholders.

Stakeholder Pressure (SP) is stakeholders’ capability and capacity to impact an organization by exerting influence on its organizational decisions [43]. Study [44] found that SP has positive impact on KM especially in the processes of acquisition, dissemination, and application. Another literature indicates that SP positively influences the KM of organizations in US manufacturing industries [45]. Furthermore, study [46] reveals a similar positive impact of SP on KM for environmental innovation. SP serves as a catalyst for organizations to acquire knowledge from diverse sources, including employees, customers, media,

government, and non-government organizations [43]. This pressure fosters individual and organizational learning, contributing to the improvement of operations and productivity [47]. In response to this pressure, dynamic organizations adopt environmentally friendly practices by integrating both existing and newly acquired knowledge into their research and development initiatives. This integration allows them to introduce new processes and advanced technologies that mitigate environmental degradation [48]. Knowledge is identified as a crucial resource to gain sustainable competitive advantage. This implies that under the SP, organizations experience a powerful momentum to acquire and apply external knowledge, which can emerge as a critical strategic support for environmental protection [44], [49].

Many companies still face challenges in acquiring, integrating, and implementing adequate knowledge to enhance value added [50]. The efficiency of companies in creating, storing, and disseminating knowledge is strongly related to the utilization and advancement of Big Data Analytics (BDA) [17]. Findings in study [51] shown that BDA capabilities are positively impact KM. In addressing growing environmental concerns, BDA's helps company provoke useful knowledge to enhance green organizational culture, products and processes, employee behavior, training, and ultimately, fostering a positive image for company. Additionally, empirical evidence indicates that BDA and KM integration improves the quality of decision-making and ensures relevant knowledge is appropriately positioned [51], [52]. Moreover, BDA has a major effect on GI, particularly in acquiring new knowledge about unforeseen challenges and identifying green business opportunities [51]. In summary, BDA capabilities enhance KM capabilities, enabling company to meet green requirements [51], [53].

2. How Knowledge Management Influence Companies with Green Innovation

KM enhances companies' GI capability [7], [29], [54]–[56] through KM dimensions, specifically knowledge search [57], knowledge creation [7], [30], [57]–[59], knowledge application [3], [7], [10], [30], [44], [51], [58]–[60], knowledge acquisition [3], [7], [10], [30], [39], [44], [51], [58]–[62], knowledge dissemination [3], [10], [44], [60], [61], knowledge sharing [7], [30], [32], [37], [58], [59], [63], knowledge responsiveness [61], and knowledge conversion [51]. Companies are leveraging knowledge resources efficiently to empower their employees to implement environmentally friendly practices [51]. They need KM to grow their capacity to effectively use natural resources [29], provide opportunities for stakeholders to collaborate [44], [59], and assure that green knowledge and practices are shared [54] to trigger the environment-friendly innovation [58]–[60]. Accordingly, the activities related to KM and a company's proficiency in utilizing and integrating various knowledge sources become important for fostering diverse types of innovation, including GI [44], [58]. Activities like gathering, integrating, leveraging, sharing, and developing environmental knowledge can be done to elevate ambidextrous GI [29], [51].

KM has both direct and indirect effects on GI, with human capitas as the mediator [56]. Human capital, including knowledge, skills, and abilities is essential to drive GI [56]. Moreover, Organizational Green Culture (OGC) moderates the

relationship between KM and GI [7], [55]. Organizational initiatives that target environmental sustainability through KM help enhance employees' knowledge regarding green practices and procedures, leading to a development of green technology and management innovations [55]. These findings [7], [55] indicate that OGC has the potential to transform organizational capabilities into GI by leveraging KM.

Digital green knowledge search is divided into scientific (SN-DGKS), supply chain (SC-DGKS), and market-based (MB-DGKS) [57]. SN-DGKS uses technologies like blockchain and big data to seek knowledge, while SC-DGKS involves supply chain participants in knowledge creation [57]. On the other hand, MB-DGKS acquires knowledge from competitors, cross-industry enterprises, and expert firms, impacting both utilizing (U-DGKC) and exploratory (E-DGKC) knowledge creation, with a stronger emphasis on utilization [57]. While SN-DGKS only impacting U-DGKC, SC-DGKS only impacting E-DGKC [57]. U-DGKC improves digital GI performance but can have drawbacks, whereas E-DGKC enhances performance through continuous iteration but may initially be detrimental [57]. Another study [59] agree that knowledge creation has a critical impact on organizational GI, but it only impacted the green technology innovation rather than green management innovation as the result indicated an insignificant impact. A different result found that knowledge creation has an insignificant association with green product development innovation and green process innovation [30]. This highlights the need for organizations to allocate more resources and attention to knowledge creation processes to enhance their GI capabilities.

KM Process (KMP), which consist of knowledge application, knowledge acquisition, and knowledge dissemination help companies streamline operations [3] and develop innovative products and processes that minimize harm to the environment [3], [30]. Furthermore, KMP significantly improve the Sustainable Development Practices (SDP) dimensions, particularly environment, economic, and social [3]. SDP focus on the implementation of environmentally conscious strategies and technologies to create products that are eco-friendly, thereby mitigating environmental pollution and reducing the risks associated with climate change [3]. SDP plays an important part in attaining GI. So, SDP mediates the link between GI and KMP to some extent. [3]. Additionally, [10] explained that knowledge properties and absorption affecting innovation efficiency; and absorptive capacity, as a series of obtaining, integrating, transforming, and exploiting external information and establishing an organizational capability, moderates the connection between GI performance and KMP.

Innovation is an effect of knowledge dissemination [61]. The more intelligence or expertise is used, the more innovative a company might be, and the more knowledge is disseminated [61]. Compared to the other two dimensions of KMP, only the association of knowledge dissemination and GI is mediated by environmental awareness [61]. Environmental awareness means the likelihood to be aware of the dangers emerged from the environmental issues and to cooperate in reducing or eliminating it and willing to participate in its resolution [61]. This research [61] suggested companies to actively communicate and implement the insights gained in order to enhance environmental awareness within their corporate strategies and operations.

Knowledge application empowers companies to create environmentally sustainable products by leveraging innovative and digital manufacturing technologies [30], [60]. Meanwhile, it is recommended to engage in knowledge search and acquisition to specifically address green issues. This aims to mitigate environmental impacts arising from the extensive utilization of resources and non-eco-friendly business processes [51]. Companies must encourage the search for external information as well, as both internal and external knowledge acquisition are essential for the innovation of green products and processes [39]. In addition, green technological innovation (GTI) and green knowledge management (GKM) are strongly impacted by green knowledge acquisition [62]. It has been shown that increasing funding for green knowledge acquisition can boost GKM and GTI methods' efficacy [62]. Consequently, [62] inferred that green-oriented companies with greater resource commitment might surpass competitors' performance with GKM and GTI enhancement.

Knowledge sharing within companies and their partners is useful to foster GI [37], as it has a serious impact on green product and process innovation [30]. Green knowledge sharing drives GI to implement environmental protection strategies [63]. Moreover, green knowledge sharing is significantly and positively impacting GI directly and indirectly through the mediating effect of green creativity [63]. This is supported by [58], in which stated knowledge has a tremendous contribution to innovation and creativity. So, green creativity means able to come up with innovative solutions while also being concerned about the environment [63]. Furthermore, mimetic pressure possesses a strong moderating impact in the relationships among green knowledge sharing and GI, and the relationship among green creativity and GI [63]. Mimetic pressure causes companies to be aware and monitor environmental security, technical knowledge, and GI activities [63]. Another moderating variable that impacts the relationship among green knowledge sharing and GI is innovation climate [32]. Low innovation climate reduces employees' innovative behavior and creativity [32]. On the contrary, high innovation climate encourages employees to seek, transfer, and assimilate their perspectives [32]. Thus, innovation climate is considerable to enable employees' collaboration for shared innovation objectives.

D. Conclusion

This study highlights the influence of Knowledge Management (KM) as an essential determinant of Green Innovation (GI). Seven factors directly influence KM implementation: green entrepreneurial orientation, knowledge-oriented leadership, green transformational leadership, embeddedness, stakeholders' pressure, training, and big data analytics capabilities. These factors contribute synergistically to the development of a knowledge-driven ecosystem, fostering green initiatives and innovation within organizations. Thereby, we advise companies to focus on these factors to ensure the successful implementation of KM. Further, the influence of KM in enhancing companies' GI capability can be achieved by searching, creating, applying, acquiring, disseminating, sharing, responding, and conversing knowledge. KM also has a significant impact on human capital, sustainable development practices, environmental awareness, and green creativity, that eventually promote GI capability. Hence, we suggest top

management to intensify their commitment regarding workforce development through KM, recognizing it as a fundamental process to enhance GI. Since this research focuses only on the literature review, empirical analysis is required to examine the conceptual model. In addition, future studies can investigate another factors to enrich the body of knowledge.

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